"AN IMPROVED IMAGE FUSION ALGORITHM BASED ON WAVELET TRANSFORMS USING PARTICLE OF SWARM OPTIMIZATION"

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ABSTRACT: *Feature based image fusion is new area of research in the field of image fusion. The image fusion used lower content of image feature. The lower content of image feature such as color texture and dimension. The texture features are very important component of image. The processing and extraction of texture feature used various transform function such as wavelet transform function, Gabor transform function and many more signal based transform function. In the process of image fusion involve two and more image for the process of fusion. The fused image still image pervious quality as well as new feature and area of improved by new and adopted reference image. In this paper, we proposed a feature based image fusion technique. The feature based optimization technique also used feature selection and feature optimization process. The feature selection and feature optimization used particle of swarm optimization technique. The particle of swarm optimization technique selects the optimal texture feature of both image original image and reference image. The original and reference image find the optimal feature sub set for the estimation of feature correlation.*

Keywords – Image fusion, wavelet transform function, swarm optimization technique, optimal texture.

1. INTRODUCTION

Computers have been widely used in our daily lives, since they can handle data and computation more efficiently and more accurately than humans. Therefore, it is natural to further exploit their capabilities for more intelligent tasks, for example, analysis of visual scenes (images or videos) or speeches (audios), which are followed by logical inference and reasoning. For we humans, such tasks are performed hundreds of times every day so easily from subconscious, sometimes even without any awareness. In computer vision applications, one of the challenging problems is the combining of relevant information from various images of the same scene without introducing artifacts in the resultant image. Since images are captured by the use of different devices which may have different sensors. Because of the different types of sensors used in image capturing devices and their principle of sensing and also, due to the limited depth of focus of optical lenses used in camera, it is possible to get several images of the same scene producing different information. Image registration is the process of systematically placing separate images in a common frame of reference so that the information they contain can be optimally integrated or compared. This is becoming the central tool for image analysis, understanding, and visualization in both medical and scientific applications. There are many image fusion methods that can be used to produce high-resolution multispectral images from a high-resolution panchromatic image and low-resolution multispectral images. Starting from the physical principle of image formation, Neural network and fuzzy theory is the two main methods of intelligence, the image fusion system based on these two methods of can simulate intelligent human behavior, do not need a lot of background knowledge of research subjects and precise mathematical model, But find the law to resolve complex and uncertainty issues on the basis of input and output data of objects. From these characteristics and the advantages, it can be seen that the use of the approachcombined by neural networks and fuzzy theory can better complete the multi-sensor image pervasive fusion.

The goal of proposed system is , the object of image fusion is to obtain a better visual understanding of certain phenomena, and to introduce or enhance intelligence and system control functions. Many advantages of multi sensory data fusion such as improved system performance (improved detection, tracking and identification, improved situation assessment, and awareness), improved robustness (lessens or redundancy and graceful degradation), improved spatial and temporal coverage, shorter response time, and reduced communication and computing, can be achieved.

2. LITERATURE SURVEY & BACKGROUND

[1] In this paper, author proposed a pixel-level image fusion scheme using multi resolution steerable pyramid wavelet transform. Wavelet coefficients at different decomposition levels are fused using absolute maximum fusion rule. Two important properties shift invariance and self reversibility of steerable pyramid wavelet transform are advantageous for image fusion because they are capable to preserve edge information and hence reducing the distortion in the fused image. Experimental results show that the proposed method improves fusion quality by reducing loss of relevant information present in individual images. For quantitative evaluation, we have used fusion metrics as fusion factor,

fusion symmetry, entropy and standard deviation. We proposed a pixel level image fusion scheme using steerable pyramid wavelet transform. In the proposed method, two main steps have to be followed: one, the source images are decomposed into low pass and high pass sub-bands of different scale using steerable pyramid, and secondly, low pass sub band is divided into a set of oriented band pass sub-bands and a low pass sub-band.

The suitability of the proposed method is tested on multi focus and medical images. For this, we have presented two pair of images and their fusion results. The results are also tested on two different conditions; when images are free from any noise and other when they are corrupted with zero mean white Gaussian noise. From experiments, we observed that the proposed method performs better in all of the cases. The performance is evaluated on the basis of qualitative and quantitative criteria.

[2] In this paper, the fusion framework based on data as simulation and genetic algorithm for Multispectral image and panchromatic image was presented. Data assimilation can combine the advantage of model operator and observe operator. Our proposed method can integrate the advantages of DWT and HIS, construct object function according to successive application to satisfy the aim of adaptively adjustment of fusion parameters. Standard deviation and average gradient are chosen as object function. In general, the higher the value, the better the texture information. And two experiments (Spot, Quick bird) validate this framework. The experiment results show that our proposed fusion frame-work is feasible.

[3] In this paper presents a comprehensive framework, the general image fusion (GIF) method, which makes it possible to categorize, compare, and evaluate the existing image fusion methods. Using the GIF method, it is shown that the pixel values of the high-resolution multi spectral images are determined by the corresponding pixel values of the low-resolution panchromatic image, the approximation of the high-resolution panchromatic image at the low-resolution level.

This paper proposes a framework, the GIF method. Under different assumptions on how the LRPI is computed and how the modulation coefficients are set, many existing image fusion methods, including, but not limited to, IHS, BT, HPF, HPM, PCA, ATW, and MRAIM, are shown to be particular cases of the GIF method. The performance of each method is determined by two factors: how the LRPI is computed and how the modulation coefficients are defined. If the LRPI is approximated from the LRMIs, it usually has a weak correlation with the HRPI, leading to color distortion in the fused image. If the LRPI is a low-pass filtered HRPI, it usually shows less spectral distortion. If the modulation coefficient is set as a constant value, the reflectance differences between the panchromatic bands and the multispectral bands are not taken into consideration, and the fused images bias the color of the pixel toward the gray. Methods in which the modulation coefficients are set following the GIF method can preserve the ratios between the respective bands, give more emphasis to slight signature variations, and maintain the radiometric integrity of the data while increasing spatial resolution.

[4] This paper addresses the image registration problem applying genetic algorithms. The image registration's objective is to define mapping that best match two set of points or images. In this work the point matching problem was addressed employing a method based on nearest-neighbor. The mapping was handled by affine transformations. This paper presents a genetic algorithm approach to the above stated problem of mis-registration. The genetic algorithm is an iterative process which repeatedly modifies a population of individual solutions. At each step, the genetic algorithm selects individual at random from the current population to be parents and uses them to produce the children for the next generation. In each generation, the fitness of every individual in the population is evaluated, multiple individuals are stochastically selected from the current population (based on their fitness), and modified (recombined and possibly randomly mutated) to form a new population. The new population is then used in the next iteration of the algorithm. Over successive generations population 'evolves' toward an optimal solution. The algorithm terminates when either a maximum number of generations has been produced, or a satisfactory fitness level has been reached for the population.

In this paper we have focused on genetic algorithm for medical image registration. Genetic algorithm is a evolutionary algorithm. There are other methods like simulated annealing, mutual information theory for image registration. Apart from this, there are other algorithms like graph algorithm and sequence algorithms. We can implement these algorithms and show the comparative study and get the most suitable for medical applications.

3. PROPOSED METHODOLOGY AND ARCHITECTRE

In this section discuss the proposed methodology of feature based image fusion technique based on wavelet transform function and particle of swarm optimization, the feature of transform function passes through feature selection process. The feature selection process used particle of swarm optimization technique. The particle of swarm optimization select the optimal feature of given texture feature matrix. If the correlation coefficient factor estimate the value of correlation is zero then fusion process is done. The process of proposed model divide into two section first section deals with initially take host image and reference image passes through wavelet transform function for feature extraction after the feature extraction applied optimization task done by particle of swarm optimization.

Step feature extraction

a. input the host image and reference image

b. apply separately Wavelet transform function for feature extraction

F(x)=I(x,y) is host image F1(x)=I1(x1,y1) is reference image

M(F)= F(x) ×G(x)

The convolution is perform in host image through transform function here M (F) stored the texture feature matrix of host image.

Then a feature vector is constructed using μ_{mn} and σ_{mn} as feature components:

f= [μ00 σ_{00} μ_{01} σ_{01} …. μ_{mn} σ_{mn}] ……..(1)

We obtain a numerical vector of 60 dimensions for 10 orientations and 6 scales changes. This moment feature value stored in M (F) matrix.

N (F) =F1(x) ×G(x)

The convolution is perform in host image through transform function here (F) stored the texture feature matrix of host image.

Then a feature vector is constructed using $\mu 1_{mn}$ and σ_{1mn} as feature components:

f= [μ100 $\sigma 1_{00}$ μ_{011} σ_{01} …. $\mu 1_{mn}$ $\sigma 1_{mn}$] ……..(2)

We obtain a numerical vector of 60 dimensions for 10 orientations and 6 scales changes. This moment feature value stored in N (F) matrix.

1. Both the feature matrix convent into feature vector and pass through particle of swarm optimization
2. step two used here particle of swarm optimization for classification of pattern Transform data to the format of an SVM that is X is original data R is transform data such that Xi∈ R^d here d is dimension of data.

Conduct scaling on the data

$\alpha = \sum_{i=1}^{m}\sum_{j=1}^{n} sim(Xi, xj) \because m * k$ here α is scaling factor and m is total data point and k is total number ofinstant and sim find close point of data.

Consider the RBF kernel K(x; y)

H(x) = exp $((-(\delta - c)2 / (r2)$ this is kernel equation of plane.

Use cross-validation to 2nd the best parameter C and

Use the best parameter C and to train the whole training set

Ro=$\alpha\frac{1}{p}\sum_{i=1}^{p} min\,(xi - yi)$ where Ro is learning parameter of kernel function.

Generate pattern of similar and dissimilar pattern of both image.

3.Estimate the correlation coefficient of both patterns using person's coefficient.

Estimate the feature correlation attribute as

$\mathrm{Rel(a,b)} = \frac{\mathrm{cov(a,b)}}{\sqrt{\mathrm{var(a)}\times\mathrm{var(b)}}}$ Here a and b the pattern of host image and reference image.

The estimated correlation coefficient data check the total value of MSE

$$\mathrm{x(t)} = \mathrm{w0} + \sum_{\mathrm{j=1}}^{\text{total data}} \mathrm{wj}\ \exp\left(\frac{-(\mathrm{total}-\mathrm{xj})}{\sigma^2}\right)$$

Create the relative feature difference value

$$\mathrm{Rc} = \sum_{\mathrm{k=1}}^{\mathrm{r}}\sum_{\mathrm{i=1}}^{\mathrm{m}}(\mathrm{hi}-\mathrm{h})(\mathrm{eik}-\mathrm{et})$$

if the relative pattern difference value is 0

4. Fusion process is done
5. Calculate PSNR value of fused image
6. Calculate IQI value of fused image
7. Calculate fusion MSER of fused image.

PROPOSED MODEL

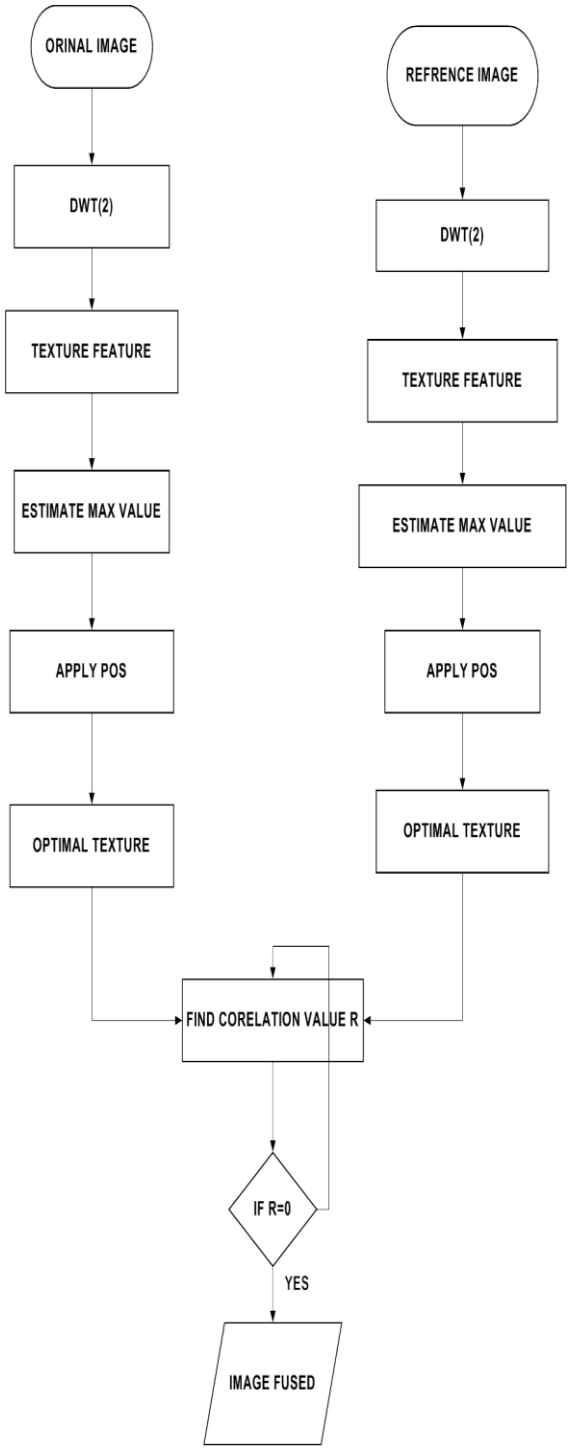

Figure 1: Proposed model of image fusion technique based on feature optimization

DESCRIPTION OF MODEL

In this section describe the process of proposed model. The proposed model contain with wavelet transform function and particle of swarm optimization. The swarm optimization used for the feature optimization process. Here discuss step of proposed model.

Step 1. Initially put the original image and reference image for the processing of feature extraction

Step 2. After processing of image discrete wavelet transform function are applied for the texture feature extraction

Step 3. After the texture feature extraction calculate the maximum value of feature using mean standard formula.

Step 4. the maximum value of feature set is global value of fitness constraints of particle of swarm optimization

Step 5. The particle of swarm optimization select the all feature as particle and measure value of difference and move according to feature direction for the processing of optimal

Step 6. The selection of optimal feature in both image estimate the correlation coefficient function of value R.

Step 7. If the value of R is 0 image are going on process of image fusion.

Step 8. If value of R not equal to 0 the processing going to estimation function.

4. RESULT ANALYSIS

To investigate the effectiveness of the proposed method for image fusion based on wavelet transform function and particle of swarm optimization. We used MATLAB software 7.14.0 and some reputed image used for experimental task such as the name given head image, head CT image, head MRI image, Heart image and Hand image. This all image is gray scale image size is 512 * 512. The performance measuring parameter is MSER, PSNR and IQI. Here we are using various types of image fusion techniques such as wavelet and Particle of swarm optimization.

IMAGE NAME	Name of method	MSER	PSNR	IQI
Head	DWT	22.03	18.30	0.955
Head	DWT-POS	26.18	20.17	0.947

Table 1: Shows that the comparative result analysis for the Head image with using DWT and DWT-POS method and we find the value of MSER, PSNR and IQI.

IMAGE NAME	Name of Method	MSER	PSNR	IQI
Head CT	DWT	17.38	15.82	1.96
Head CT	DWT-POS	23.67	18.29	0.953

Table 2: Shows that the comparative result analysis for the Head CT image with using DWT and DWT-POS method and we find the value of MSER, PSNR and IQI.

IMAGE NAME	Name of Method	MSER	PSNR	IQI
Head MRI	DWT	15.89	14.43	1.964
Head MRI	DWT-POS	22.15	16.84	0.957

Table 3: Shows that the comparative result analysis for the Head MRI image with using DWT and DWT-POS method and we find the value of MSER, PSNR and IQI.

IMAGE NAME	Name of Method	MSER	PSNR	IQI
Heart	DWT	22.17	18.43	0.954
Heart	DWT-POS	26.53	21.01	0.943

Table 4: Shows that the comparative result analysis for the Heart image with using DWT and DWT-POS method and we find the value of MSER, PSNR and IQI.

IMAGE NAME	Name of Method	MSER	PSNR	IQI
Hand image	DWT	24.76	20.86	0.948
Hand image	DWT-POS	29.06	23.41	0.940

Table 5: Shows that the comparative result analysis for the Hand image with using DWT and DWT-POS method and we find the value of MSER, PSNR and IQI.

COMPARATIVE RESULT GRAPH

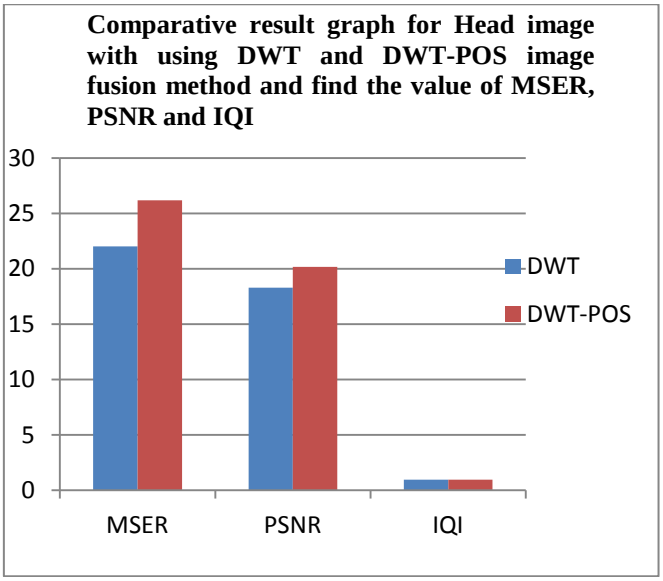

Figure 2: Shows that the comparative result graph for Head image with using DWT and DWT-POS image fusion method and find the value of MSER, PSNR and IQI.

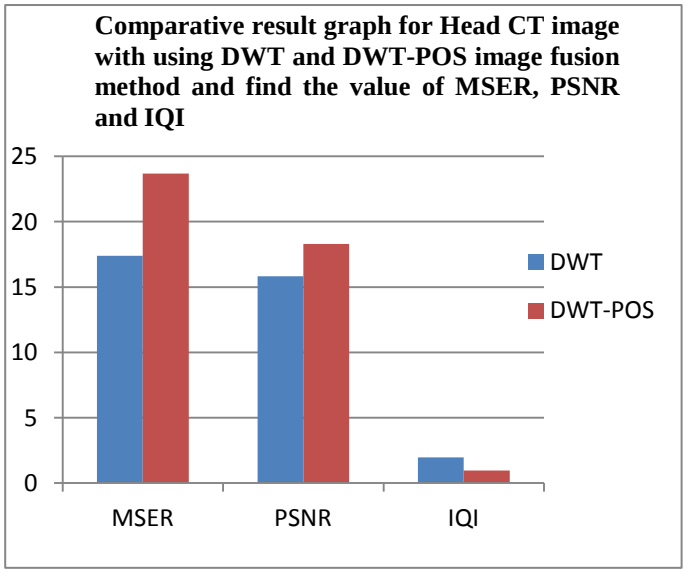

Figure 3: Shows that the comparative result graph for Head CT image with using DWT and DWT-POS image fusion method and find the value of MSER, PSNR and IQI.

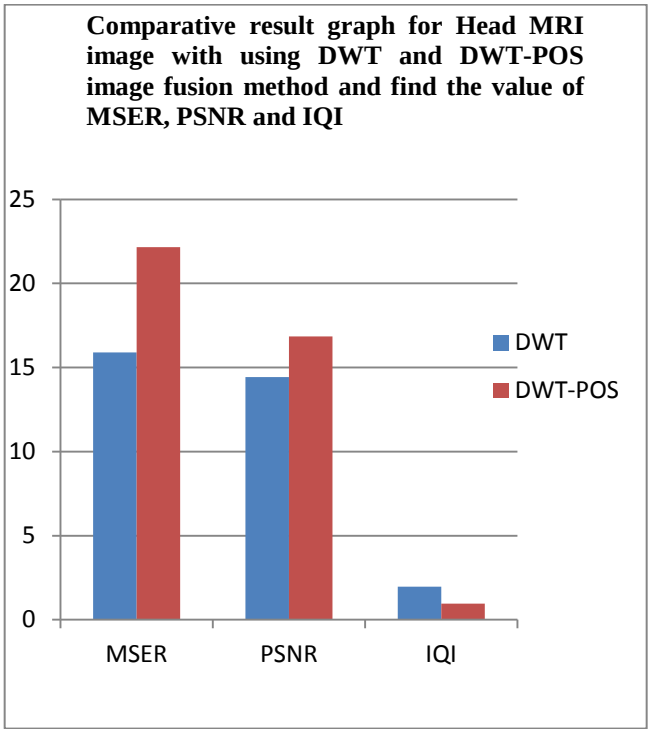

Figure 4: Shows that the comparative result graph for Head MRI image with using DWT and DWT-POS image fusion method and find the value of MSER, PSNR and IQI

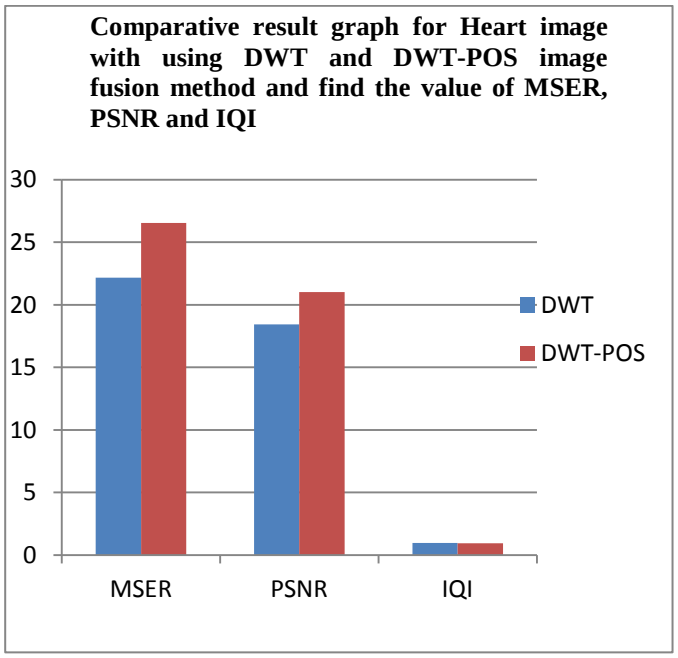

Figure 5: Shows that the comparative result graph for Heart image with using DWT and DWT-POS image fusion method and find the value of MSER, PSNR and IQI

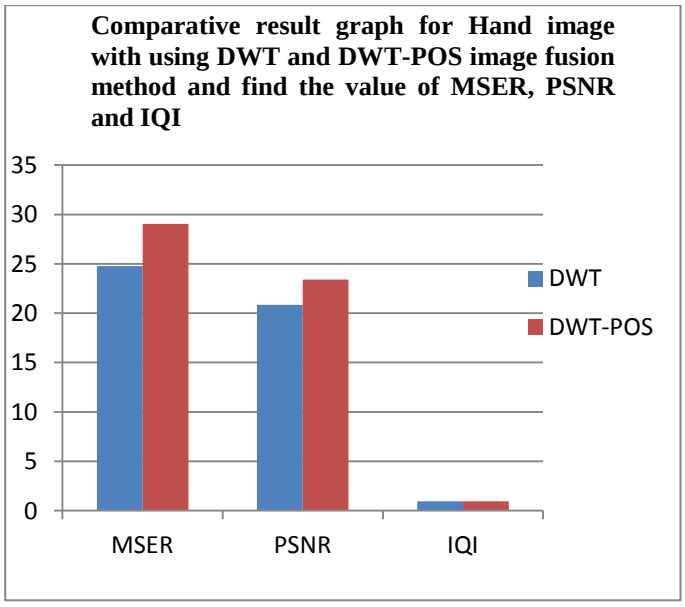

Figure 6: Shows that the comparative result graph for Hand image with using DWT and DWT-POS image fusion method and find the value of MSER, PSNR and IQI

5. CONCLUSION

In this dissertation proposed a feature based image fusion technique for the improvement of quality of image of distorted and damage image. The process of proposed algorithm used wavelet transform function for the feature extraction process. The wavelet transform function extract the lower content of texture feature. The lower content of texture feature used for the process of feature optimization process. The feature optimization process done by particle of swarm optimization. Particle of swarm optimization is dynamic population based optimization technique. The correlation coefficient factor estimate the relation of original image and reference image. If the value of correlation is 0 then image are fused. If the value of relation is not equal to zero the estimation factor recall. Measure the quality of fused image measures are considered. These measures play an important role in various Image Processing applications. Goal of image quality assessment is to supply quality metrics that can predict perceived image quality automatically. While visual inspection has limitation due to human judgment, quantitative approach based on the evaluation of "distortion" in the resulting fused image is more desirable for mathematical modeling. The goals of the quantitative measures are normally used for the result of visual inspection due to the limitations of human eyes. In Mathematical modeling, quantitative measure is desirable. One can develop quantitative measure to predict perceived image quality. In this dissertation used PSNR, IQI and MSER for estimation of quality of image.

6. FUTURE WORK

The proposed method of image fusion is very efficient for the process of image quality improvement. The process of fusion produces good result in term of quantitative analysis. But it still needs some improvement in IQI parameter. The maximum value of IQI is 1. But in this dissertation only reached 97-98% for quality factor. In future improve the value of IQI up to 1. For this used two or more feature combined with texture feature.

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